1992

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Abstract: We caught 19 adult (>1.5 years old) whooping cranes (*Grus americana*) in 84 capture attempts (23% success) by night-lighting during 1981–91 in Idaho, Wyoming, and New Mexico, including 17 for experimental purposes and 2 that were debilitated (avian cholera and lead poisoning). We also captured 250 greater sandhill cranes (*G. canadensis tabida*), including 157 adults and 93 juveniles, on summer areas at Grays Lake National Wildlife Refuge, Idaho, to color-mark them for behavioral and movement studies. Night-lighting equipment included an 8.5-kg portable generator mounted on an aluminum back-pack frame and a 12- or 28-V spotlight mounted on a helmet. Large fish landing nets with 3.0- to 3.6-m handles were used to capture cranes. Capture success was influenced by the presence of other avian species, habitat type, weather, and nocturnal conditions such as moon phase and amount of starlight. Cranes were most easily caught when roosting with few other cranes and other aquatic birds on very dark, overcast nights or during inclement weather. Night-lighting was a safe, effective, but strenuous technique for capturing cranes widely dispersed on summer areas and for targeting specific individuals. Fifty-three other avian species were captured with the back-pack night-lighting unit.

Key Words: capture, *Grus americana*, *G. canadensis*, night-lighting, sandhill crane, whooping crane

PROC. NORTH AM. CRANE WORKSHOP 6:43-49

Capturing adult sandhill cranes when they are widely dispersed during the breeding season is difficult. The primary technique for capturing adult sandhill cranes has been rocket-netting (Littlefield and Ryder 1968, Wheeler and Lewis 1972, Williams and Phillips 1973, Drewien and Bizeau 1974, Nesbitt 1976, Ramakka 1979, Tacha 1979, Toepler and Crete 1979, Williams 1981, Tacha et al. 1982, Pogson et al. 1988, Bennett and Bennett 1989). Smaller numbers have been captured with oral tranquilizers (Williams and Phillips 1973; Nesbitt 1976, 1984; Tebbel and Ankney 1979; Williams 1981), a walk-in trap (Logan and Chandler 1987), by night-lighting (Drewien et al. 1967, Drewien and Bizeau 1974), and occasionally by running down flightless molting adults (Boise 1979, Drewien et al. 1987).

Except for night-lighting, most capture techniques have limited application for catching widely dispersed adult sandhill cranes during the breeding season or for capturing specific individuals. Further, some mortality was associated with rocket-netting (Wheeler and Lewis 1972, Williams and Phillips 1973, Nesbitt 1976, Ramakka 1979, Williams 1981, Tacha et al. 1982) and oral tranquilizers (Williams and Phillips 1973; Nesbitt 1976, 1984; Williams 1981), making those methods unacceptable for capturing endangered species.

We first captured greater sandhill cranes on nesting areas at Grays Lake National Wildlife Refuge, Idaho (Grays Lake), by night-lighting in 1969–71 to band and color-mark them for behavioral and migration studies (Drewien and Bizeau 1974). We continued to capture sandhill cranes by night-lighting at Grays Lake for research studies through the 1980's.

With initiation of the whooping crane cross-fostering experiment in the Rocky Mountain region in 1975 (Drewien and Bizeau 1978), we needed a safe and reliable technique to capture fledged whooping cranes. Our success with night-lighting sandhill cranes at Grays Lake indicated that the technique was viable and safe for capturing wild, adult whooping cranes, which had never been caught before.

In May 1981, a 3-year-old captive-reared female whooping crane from Patuxent Wildlife Research Center, Maryland (Patuxent), was transferred to Grays Lake for release on the territory of a solitary, wild male. The purpose of the experiment was to enhance pair formation opportunities because no wild females summered at Grays Lake at that time. No solid pair bond had developed by fall migration in October, so we used night-lighting to capture the female and return her to Patuxent.

In the mid-1980's, we again employed night-lighting to catch 2 debilitated whooping cranes at the Bosque del Apache National Wildlife Refuge, New Mexico (Bosque Refuge), the primary wintering area for cross-fostered whooping cranes (Drewien and Bizeau 1978). From 1986 to 1991, we used night-lighting as the primary technique to capture adult whooping cranes for translocation experiments to enhance pairing opportunities among cross-fostered whooping cranes. This paper describes night-lighting techniques we used to capture adult whooping cranes in 3 states and greater sandhill cranes dispersed on summer areas at Grays Lake.

We thank the individuals who assisted us with the

night-lighting project, including S. H. Bouffard, W. M. Brown, D. D. Call, B. Clegg, D. W. Clegg, B. E. Drewien, M. Hawkes, B. Mullins, and R. E. Stoor. We thank E. G. Bizeau, W. M. Brown, F. G. Cooch, J. C. Lewis, R. E. Shea, and D. W. Stahlecker for reviewing this manuscript. T. L. Jones kindly typed the manuscript. The study was funded by the U.S. Fish and Wildlife Service.

STUDY AREAS

All night-lighting for sandhill cranes occurred at Grays Lake. Grays Lake is a high-elevation (1,946-m) 8,900-ha marsh in southeastern Idaho and is described by Drewien and Bizeau (1978) and Drewien et al. (1985).

Whooping cranes were captured on summer areas in isolated wetlands in Bonneville, Clark, and Teton counties in eastern Idaho, and in Lincoln and Sublette counties in western Wyoming. Whooping cranes were also caught on their winter site at the Bosque Refuge in the middle Rio Grande Valley, New Mexico; this area is described by Taylor and Kirby (1990).

METHODS

We initially captured sandhill cranes by night-lighting with a 6.4-kg generator mounted on a back-pack (Drewien et al. 1967). Because the manufacturer discontinued production of this generator, we experimented with newer models. In 1981, we selected an 8.5-kg generator (Tanaka model AQB-300, 12-V DC/110-V AC), mounted it on a plywood platform, and attached it to an aluminum back-pack frame (Drewien et al. 1967:779). For safety, a turn-off switch was mounted in an accessible location on the lower side of the pack frame. The exhaust manifold above the muffler was modified by drilling a 12.2-mm hole and plugging it with a bolt. The bolt was removed if increased noise was needed. Ear plugs and a helmet with foam padding were worn for hearing protection.

The generator served as a power source for 12-V spotlights or aircraft landing lights (GE #4553, 28 V, 250 W) attached to a football helmet. Large salmon landing nets with various length (3.0- to 3.6-m) handles were used to catch cranes. We wore hip boots or chest waders as appropriate.

Night-lighting normally involved a 2-person crew with hand netting performed by the back-pack unit operator. The second person followed 10–50 m behind and assisted the operator in handling captured cranes. To capture cranes we searched night roosts during dark phases of the moon. The unit operator walked at a normal pace scanning open water areas and along edges of tall, dense, emergent aquatic vegetation (mainly *Scirpus acutus, Typha latifolia*, and *Salix* sp.) for cranes. When a crane(s) was seen, a direct approach was normally made while keeping the light on the bird(s). After capture, cranes were placed in burlap bags until they were banded, color-marked, and released, or transported to other locations.

We recorded response of cranes to night-lighting, habitat use, association with other species, weather conditions, and other factors. We used the *t*-statistic to test the significance of capture rates for sandhill cranes under different nocturnal conditions and for whooping cranes between summer and winter areas. We frequently encountered other avian species while night-lighting and noted their susceptibility to capture.

RESULTS

Capturing Sandhill Cranes

We captured 250 sandhill cranes, including 93 juveniles, in 94 nights (Tables 1 and 2). Seventeen juveniles were fledged and 76 were flightless. Generators or lights failed within the first 30 min on 14 nights, terminating our capture efforts. Excluding these 14 nights, our mean capture rate per night for sandhill cranes in 80 nights was 3.1 (range = 0–12) (Table 2).

Capture efforts were directed mainly at adults occupying breeding territories between May and September, although most were captured in July and August. Juveniles associated with their parents were captured and color-marked. Except in September, cranes were widely dispersed as pairs, individual families with young on breeding territories, or in non-breeder groups of 3 or more.

Knowledge of night roost locations, familiarity with approaches to roosts, and physical characteristics of individual roost sites were prerequisites for capture success. We watched cranes enter roosts on evenings before night-lighting. It was best to night-light 3–5 hrs after dark, giving cranes ample time to settle down. Capture attempts were less productive 1–2 hours after dark because cranes often flushed.

To minimize disturbance, we parked vehicles 1–2 km away and walked to within 200–400 m of roosts before starting the generator. Once cranes were sighted, we kept the light directed at target individuals. Detours were made around physical obstacles and aquatic birds to avoid flushing them and alarming cranes. Cranes were approached at a fast walk. If the approach was too slow, cranes would often walk, run, or fly. However, if the operator ran toward the cranes, they apparently heard water splashing and flushed.

If more than 2–6 cranes were in a group, the best capture success was achieved by selecting individuals on

the edges of flocks and isolating them with the light. The disturbance created by catching a crane alarmed others and they often departed. An experienced crew, however, could catch 2–3 cranes from the same flock.

After a crane was captured, the second crew member assisted the operator by removing the crane from the net and putting it in a burlap bag. The operator then continued night-lighting. If more than 1 or 2 persons assisted the operator, capture success usually declined due to noise and disturbance created by additional people walking through vegetation, splashing through water, and flushing other aquatic birds.

Capture success was always enhanced if we could position cranes between the operator and a background of tall, dense, emergent vegetation. The vegetation functioned as a barrier between the operator and a crane's escape route. It also obscured the horizon and reflected light from the spotlight, which helped to disorient cranes. Cranes occasionally attempted to hide in dense vegetation where they were easily caught.

The amount of natural or artificial sky light influenced capture success. Cranes flushed more readily when horizons were visible, and capture rates declined with abundant starlight or artificial lights from buildings or municipalities. As a rule, capture conditions were marginal if the crew could walk to the roost area without aid of artificial light.

Significantly more cranes were caught on nights with cloud cover or inclement weather than on clear starlit nights ($P < 0.003$, $t = 4.13$) (Table 2). Highest capture rates occurred on very dark nights with heavy overcast or fog because cranes were reluctant to fly. For safety, however, we avoided night-lighting during electrical storms.

Repeated night-lighting, especially on consecutive nights, reduced capture success. Cranes rapidly became conditioned to the disturbance and flushed at greater distances. One or 2 entries into a roost in a 2-week period during the dark phase of the moon were optimal.

Caution was exercised when handling cranes, especially adults, because they usually struggled and attempted to peck and scratch handlers. Juveniles were normally less aggressive.

One of the 250 captured cranes was injured during capture. This crane was disoriented by the light and flew into the operator, injuring a wing.

On 2 occasions we successfully night-lighted cranes from a 4 × 4 All Terrain Vehicle (ATV, 4-wheeler). The ATV, however, functioned well only in water depths <0.5 m, which limited its use to shallow marsh zones.

We found no evidence that night-lighting excessively disturbed or caused cranes to vacate areas while they were dispersed during the breeding season. After catching cranes, we banded and color-marked them at or near capture sites (≤200 m) and released them. After release, cranes continued to occupy areas close to capture locations. We captured 5 incubating females on nests; all continued incubation and hatched eggs. In September, when cranes were gregarious, repeated night-lighting (2–3 consecutive nights) of large flocks caused some individuals to move up to 6 km to new roost sites.

Table 1. Numbers and locations of whooping cranes and greater sandhill cranes captured by night-lighting, 1969–91.

Species	Location	No. cranes captured		
		Adult	Juvenile	Total
Whooping crane	Idaho and Wyoming	14		14
	New Mexico	5		5
Greater sandhill crane	Grays Lake NWR, Idaho	157	93	250

Table 2. Numbers of greater sandhill cranes captured by night-lighting under various nocturnal conditions at Grays Lake National Wildlife Refuge, Idaho, 1969–91.

Nocturnal conditions	No. nights	No. cranes captured	$\bar{x}$	SD	Range
Clear skies	57	133	2.3	1.7	0–8
Overcast/inclement weather	23	112	4.9	2.7	3–12
(Equipment failure)[a]	(14)	(5)	(0.4)	(0.6)	(0–1)
Total	80(94)	245(250)	3.1	2.3	0–12

[a] Equipment problems occurred within 30 min of initiation of night-lighting and efforts were terminated; capture data not included in calculation of total $\bar{x} \pm$ SD.

Capturing Whooping Cranes

During 1981–91, we captured 19 adult (1.5- to 14.5-year-old) whooping cranes by night-lighting. Fourteen were caught on individual summer areas in eastern Idaho and western Wyoming for translocation and pairing experiments with the whooping crane cross-fostered flock (Drewien and Bizeau 1978). Five others were captured at

Table 3. Capture success and response of adult (> 1.5-yr-old) whooping cranes to night-lighting in Idaho, Wyoming, and New Mexico, 1981–91.

Location	Crane response when not captured: Flushing distance (m) <10	11-50	>50	Not obs	Cranes captured	Capture attempts	Capture success (%)
Summer Areas[a]							
Wild cranes	3	5	14	11	13	46	28
Captive released female[b]		1		1	1	3	33
Winter Area[c]							
Wild cranes	5	17	8		3	33	9
Debilitated cranes[d]					2	2	100
Total	8	23	22	12	19	84	23

[a] Eastern Idaho and western Wyoming.
[b] Captive-reared female from Patuxent Wildlife Research Center, Laurel, Maryland, released at Grays Lake NWR, Idaho, in May 1981 and recaptured October 1981.
[c] Bosque del Apache NWR, New Mexico.
[d] Two whooping cranes suffering from lead poisoning and avian cholera at the Bosque del Apache NWR.

Bosque Refuge, the primary winter site for the population. Eighteen of the 19 were wild, cross-fostered cranes and the other was a female whooping crane raised in captivity at Patuxent and released at Grays Lake in a pairing experiment.

The same factors influencing capture success for sandhill cranes also applied to whooping cranes. The primary difference was that we targeted the capture of specific individuals, a more difficult process than catching any sandhill crane encountered. Consequently, we attempted to select nights with optimal capture conditions, choosing inclement weather or very dark overcast nights, and avoiding situations where the individual roosted with flocks of cranes. The first attempt at capture was usually the most productive. Repeated attempts because earlier efforts were unsuccessful made it increasingly difficult to approach an individual. We rarely attempted to catch specific individuals after 3 consecutive attempts as they would always flush out of capture range.

Whooping cranes were reluctant to fly and were readily caught in inclement weather. For example, we caught an 8-year-old male in a snowstorm. As we approached, he ran about 50 m from a small pond into the uplands and crouched down in a hiding posture where we captured him. We also easily caught 2 others in fog.

Responses of whooping cranes to capture attempts varied. In 84 attempts, 19 (23%) were caught, 12 (14%) were never observed in roosts they had entered, and in 53 (63%) attempts they flushed at various distances (Table 3).

Capture success varied by location and time of year. Fourteen adults were caught in 49 attempts (29% success) on summer areas compared to 3 caught in 33 attempts (9% success) on the winter area (Table 3). The difference between capture rates was significant ($P < 0.02$, $t = 2.36$). Two other whooping cranes captured in New Mexico were debilitated and behaving abnormally. Both were easily captured on first attempts (Table 3) and were treated by veterinarians in Albuquerque, New Mexico. One crane suffered from avian cholera (Snyder et al. 1987) and the other from lead poisoning (Snyder et al., in press).

The higher capture rate on summer areas is attributed to individual whooping cranes being widely dispersed, roosting alone or with a few sandhill cranes, and often in small wetland roosts surrounded by tall, dense, emergent vegetation. In contrast, whooping cranes wintering at Bosque Refuge roosted in open wetlands occupied by thousands of sandhill cranes and other waterfowl. In these conditions it was extremely difficult to approach the target individual without alarming and flushing large numbers of birds.

Other Avian Species Captured

We encountered many avian species in wetlands or in adjacent uplands while night-lighting for cranes. We captured 53 additional species, including 49 at Grays Lake. Twenty species belonged to the family Anatidae (Table 4).

Many avian species were easily approached and

Table 4. Fifty-five avian species captured with a back-pack night-lighting unit in Idaho and New Mexico, 1981-91.[a] Susceptibility to capture is rated (1) difficult, (2) moderate, and (3) easy.

Species captured	Susceptibility to capture	Species captured	Susceptibility to capture
Pied-billed grebe (*Podilymbus podiceps*)	2	American coot (*Fulica americana*)	3
Eared grebe (*P. nigricollis*)	2	Sandhill crane (*Grus canadensis tabida*)	1
American bittern (*Botaurus lentiginosus*)	2	Whooping crane (*G. americana*)	1
White-faced ibis (*Plegadis chihi*)	2	Killdeer (*Charadrius vociferus*)	3
Tundra swan (*Cygnus columbianus*)[b]	2	Black-necked stilt (*Himantopus mexicanus*)	3
Trumpeter swan (*C. buccinator*)	2	American avocet (*Recurvirostra americana*)	3
Canada goose (*Branta canadensis*)	3	Willet (*Catoptrophorus semipalmatus*)	2
Green-winged teal (*Anas crecca*)	3	Spotted sandpiper (*Actitis macularia*)	2
Mallard (*A. platyrhynchos*)	2	Long-billed curlew (*Numenius americanus*)	2
Northern pintail (*A. acuta*)	2	Common snipe (*Gallinago gallinago*)	2
Blue-winged teal (*A. discors*)	3	Wilson's phalarope (*Phalaropus tricolor*)	2
Cinnamon teal (*A. cyanoptera*)	3	Frankin's gull (*Larus pipixcan*)	2
Northern shoveler (*A. clypeata*)	3	Black tern (*Chlidonias niger*)	3
Gadwall (*A. strepera*)	3	Horned lark (*Eremophila alpestris*)	2
American wigeon (*A. americana*)	2	Marsh wren (*Cistothorus palustris*)	3
Canvasback (*Aythya valisinera*)	3	Yellow warbler (*Dendroica petechia*)	2
Redhead (*A. americana*)	3	Common yellowthroat (*Geothlypis trichas*)	3
Ring-necked duck (*A. collaris*)	3	Brewer's sparrow (*Spizella breweri*)	2
Lesser scaup (*A. affinis*)	3	Vesper sparrow (*Pooecetes gramineus*)	2
Common goldeneye (*Bucephala clangula*)	2	Savannah sparrow (*Passerculus sandwichensis*)	2
Barrow's goldeneye (*B. islandica*)	2	Song sparrow (*Melospiza melodia*)	2
Bufflehead (*B. albeola*)	2	Lincoln's sparrow (*M. lincolnii*)	2
Common merganser (*Mergus merganser*)	2	White-crowned sparrow (*Zonotrichia leucophrys*)	2
Ruddy duck (*Oxyura jamaicensis*)	3	Red-winged blackbird (*Agelaius phoeniceus*)	3
Northern harrier (*Circus cyaneus*)	2	Western meadowlark (*Sturnella neglecta*)	2
Sage grouse (*Centrocercus urophasianus*)	3	Yellow-headed blackbird (*Xanthocephalus xanthocephalus*)	3
Virginia rail (*Rallus limicola*)	2	Brewer's blackbird (*Euphagus cyanocephalus*)	2
Sora (*Porzana carolina*)	2		

[a] Forty-nine species were captured at Grays Lake NWR, Idaho.
[b] Drewien et al. (in press).

captured by hand, especially ducks. Some smaller species (i.e., common snipe and sparrows) usually flushed before we saw them. Holding the light on a flushed bird often disoriented it, causing it to land where it was easily captured.

The only species we encountered that we were unable to closely approach were snow (*Chen caerulescens*) and Ross' (*C. rossii*) geese in large flocks at Bosque Refuge, New Mexico. When searching for whooping cranes, we usually encountered these geese, and most flushed at distances of 20–250 m. In contrast, Canada geese were easily captured.

DISCUSSION

Night-lighting is an effective technique for capturing adult sandhill cranes and whooping cranes dispersed during spring and summer and for targeting specific individuals. The mobility of the back-pack unit allowed us to capture cranes in various wetland habitats, including sites in isolated mountainous terrain inaccessible to conventional trapping techniques. The probability of injury to cranes from night-lighting is minimal, making it acceptable for capturing endangered cranes and other avian species. Night-lighting also proved useful in catching debilitat-

ed whooping cranes needing medical attention.

Although we primarily used the night-lighting unit on foot, it can be used from vehicles and boats. We used the unit in 1990 and 1991 to capture 425 trumpeter swans from boats in harsh winter weather conditions in eastern Idaho and southwestern Montana (Drewien et al., in press; Drewien and Clegg 1992).

Of 55 avian species captured by night-lighting, adult cranes were the most difficult because of their wariness and readiness to hide, run, or fly (Table 4). Whooping cranes were slightly easier to approach than sandhill cranes. They tended to remain in roosts longer and appeared more reluctant to fly at night, providing better capture opportunities.

The same factors influencing capture success by night-lighting for waterfowl and upland game (Drewien et al. 1967) were applicable to catching cranes. Increasing engine-generator noise by modifying the muffler improved capture rates. Care in eliminating shadows of the operator across the light beam and preventing backlighting that would expose the operator were important for successful captures. Improvements in generators and sealed beam spotlights provided a more reliable night-lighting unit compared to the original design (Drewien et al. 1967). The same safety precautions discussed for the original unit apply to the current engine-generator.

Night-lighting has some disadvantages. It is not suitable for catching large numbers of cranes in a short period of time nor effective in roosts with large numbers of cranes. After 1–3 cranes were caught, the disturbance from capture and handling caused others to flush. Our maximum catch was 6 in a roost containing 300± cranes. Cranes should not be night-lighted where flushed birds could collide with aerial hazards such as nearby power-lines, fences, or trees.

Night-lighting is time consuming and strenuous. It involves observing cranes going to roosts and evaluating physical characteristics of roosts before capture efforts. In soft, boggy substrate, an operator usually cannot catch cranes if they walk away.

Only a few other attempts to catch sandhill cranes by night-lighting have been reported. Wheeler and Lewis (1972:16) reported on 2 unsuccessful attempts during spring in the Platte River Valley, Nebraska. Stephen (*in* Wheeler and Lewis 1972:2) apparently was unsuccessful in catching cranes with lights in Saskatchewan. Lewis (1974) made several unsuccessful attempts to catch migrating or wintering cranes in Nebraska, Oklahoma, and Texas. Several attempts in 1984 to capture sandhill cranes in Michigan with spot-lights and taped recordings of noises were also unsuccessful (R. P. Urbanek, U.S. Fish and Wildlife Service, pers. commun.). Most of these efforts were with inadequate equipment and were mainly directed at larger flocks.

Limited knowledge of methods and lack of available equipment has probably resulted in minimal use of this technique. Not only is proper equipment needed, but capture success is related to experience of the crew. Operators learn the subtleties of how to maneuver themselves and cranes into position for successful capture. Selecting nights with proper environmental conditions enhances success. Night-lighting works best for special studies on limited areas where there is a need to catch cranes dispersed during the breeding season or in small flocks. The technique also has wider application for capturing many aquatic and ground-dwelling birds.

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